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(54) Title: RISK ASSESSMENT AND MEASUREMENT METHOD AND SYSTEM

(57) Abstract: In one form the present invention provides a method, system and computer program product for determining the risk of capital value of a financial instrument falling below a pre-determined ratio of the financial instrument's property value at sale, the method including: f) obtaining data related to the value of the property, g) determining which of the data fit within predetermined guidelines, and retaining the data, h) grouping the retained data, in accordance with sub-market criteria, i) determining a mid-point value of each of the grouped data, together with corresponding mean, standard deviation and serial correlation values, and determining, relative to the mid-point, mean, standard deviation and serial correlation values, the likelihood the property value will fall below the predetermined ratio. The present invention also provides a method, system and computer program product for assessing whether a property value is likely to fall to a predetermined value. The present invention is applicable to any financial instrument such as, property, shares, etc. against which a financial facility, for example a loan, might be granted and which financial instrument, fluctuates/grows in its value or market price. The present invention, in one form, has been developed for use in the financial sector, particularly in the field of banking, but also has application in mortgage securitisation, mortgage insurance and other areas where the identification and measurement of the probability of capital loss and/or negative equity for residential real estate is important.

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RISK ASSESSMENT AND MEASUREMENT METHOD AND SYSTEM

FIELD OF INVENTION

The present invention relates to the financial and banking sectors of business. In one form, the present invention is a residential real estate (RRE) capital value risk identification and estimation tool. In other form(s), the present invention is applicable to any financial instrument such as, property, shares, etc. against which a financial facility, for example a loan, might be granted and which financial instrument, fluctuates/grows in its value or market price. The present invention, in one form, has been developed for use in the financial sector, particularly in the field of banking, but also has application in mortgage securitisation, mortgage insurance and other areas where the identification and measurement of the probability of capital loss and/or negative equity for residential real estate is important.

BACKGROUND OF INVENTION

The traditional residential real estate (RRE) risk assessment tool for lending and mortgage insurance is the Loan to Value ratio (LVR). The LVR is defined as the mortgage amount at loan commencement divided by the security value at loan commencement. For a number of years, any loan that exceeds a Loan to Value ratio (LVR) of 80% is considered to be "risky" and generally requires mortgage insurance. Loans written at less than a 80% loan to value ratio are considered to be "safe". Lenders and Mortgage insurers alter policy from time to time, depending upon local geographic conditions and may consider not lending or insuring at any price. To date, these risk adjustments tend to be intuitive or semi-empirical.

Banking and insurance are considered mature, highly competitive industries with little (considered) chance for differentiation in the market. Banks constantly strive to develop and offer new products and reduce costs.

Banks are in the process of reviewing the role of the traditional Valuer / Appraiser in the lending process in order to reduce cost and speed up process. Statistically derived, automated valuations are becoming more common in the USA and Canada. Australia is starting to follow this path. In essence, the current trend in relation to residential real estate risk assessment is to continue to use a loan to value ratio, but in a manner which is quicker and cheaper and which

works on the basis of a "portfolio" of risks. The portfolio of risks is believed to enable exposure to relatively risky loans to be offset with exposure to relatively less risky loans.

The concept of negative equity is considered important in residential financial areas including lending, insurance securitisation, and investment. Negative equity is the term used when the value of a property falls below the outstanding loan amount of the property. It has been clearly demonstrated that negative equity often becomes a trigger for loan delinquency, default and mortgage insurance claims.

Standard and Poor's notes that "the major" causes of default in Australia are generally considered to be:

- Loan affordability
- Loss of income
- Personal crisis

OR any of the above accompanied by declining property values.

According to Robert Schiller (1996,Journal of Real Estate Research,Vol.7, Issue 2, p248), one of the world's most well respected finance researchers and practitioners:

"there is no shortage of evidence on the importance of house prices and equity in the default decision".

Quercia and Stegman (1992, Journal of Housing Research, Vol.3, Issue 2, p375) reviewed 29 empirical studies done over a 30-year period and concluded:

"Consistently, home equity, or the related measure of loan to value ratio, has been found to influence the default decision. There is consensus in most recent default studies that the correct measure of a borrower's net equity is the contemporaneous market value of the property less the contemporaneous value of the loan,......."

Kau, Keenan and Kim (1994, Journal of Urban Economics, Vol.35, Issue 3, p287) reached the same conclusion:

"There exists a significant literature examining the causes of default. In conformity with this paper's approach, considerable empirical evidence exists showing that it is the house versus the mortgage value, rather than such personal characteristics as the homeowner's liquidity position, that explains default."

In a study using a discrete proportional hazard model, micro-level mortgage data from Freddie Mac, and weighted repeat sales price indices, Quigley, Van Order and Deng (1993, the Competing Risks for Mortgage termination by Defaults and Prepayments in the Residential Housing market, paper presented at National Bureau of Economic Research Summer Institute, Cambridge, MA, USA, at p24) stated:

"The results show that the probability of negative equity ratio is the main time varying covariate influencing mortgage holders default decisions"

In a recent investigation into mortgage defaults in Australia, Berry et. al. (1999, Falling Out of Home Ownership, Mortgage Arrears and defaults in Australia, University of Queensland Press, ISBN: 1 875997 32 6 at p.37) summarized findings:

"mortgage default is viewed from an option taking perspective in which the level of owner's equity, captured by the LVR, is the key causal factor. There is increasing agreement that the correct measure of equity is the difference between current market value of the dwelling and the current market value of the mortgage, rather than the level of equity implicit in the initial LVR."

SUMMARY OF INVENTION

It is an object of the present invention to provide a method, system and computer program product which enables capital risk identification and an associated estimation tool therefore.

The present invention provides a method, system and computer program product as outlined in the specification and as defined in the attached claims. Furthermore, the invention as outlined in the specification and as defined in the attached claims provides a method of providing a financial facility for a transaction involving a financial instrument.

The present invention has come about by realising that the loan to value ratio is a gross generalisation in respect to residential real estate risk. In coming to realise the present invention, research suggests that residential real estate sub-markets, measured at a very fine level of disaggregation, have very different risk profiles. An example of a sub-market is a real estate market specified in terms of geographic location (zip/postcode), type (house / non house) and price (subdivisions /categories). Equally, it should be understood that sub-markets

may be determined for any other financial instrument, such as shares for example, where it is suggested that such sub-markets, measured at a very fine level of disaggregation, have very different risk profiles

In most cases, the 80% loan to value ratio marker is considered a gross overstatement or understatement of the real sub-market risk. In addition, the measure of risk for a given sub-market is dynamic, and will tend to change depending upon underlying factors such as economic cycles, price levels and/or other economic and non-economic events.

In addition, it has been realised that the real residential real estate or other properties risk occurs not only at the time of arranging the financial facility but is significant for a period of years. That period varies on financial conditions and the terms of the mortgage, but 5 years is considered a reasonable period for domestic mortgages. During this period, the loan principal has usually been reduced by a relatively small amount, whereas property markets and economies may have changed significantly. It is during this 3 to 5 year period from the commencement of the loan that the residential real estate security risk exists. The present invention is directed, in one aspect to the identification and measurement of the probability of "negative equity" or the outstanding loan amount exceeding the value of the financial instrument at any time during this period. It is considered that this is the real measure of risk, not the initial loan to value ratio(LVR).

The present invention has a number of advantages, which include:

That it will allow users in the finance industry to improve their risk assessment in the RRE market. In turn, this will allow them to better direct their business and minimise losses. Another benefit of the present invention is to allow increased returns on a risk adjusted basis. That it will enable estimation of the probability of negative equity (value less than outstanding loan balance) at a user set confidence level for a period 3 to 5 years in the future. This calculation can be undertaken for any financial instrument, for example, residential property type or value in any location, where sufficient historical data is available.

An example output may be as follows:

Example 1 - Ballarat decile 1 (<u>lowest 10%</u>) houses:

1. To be 95% confident of no negative equity in this residential real estate sub-market, lend only up to 89% (approx) of the current value.

2. There is a 23.3% chance that this residential real estate sub-market will fall below its current value within the next 5 years.

3. There is a 76.7% chance that this residential real estate sub-market will not fall below it's current value within the next 5 years.

Example 2 - Toorak decile 1 (lowest 10%) houses:

1. To be 95% confident of no negative equity in this residential real estate sub-market, lend only up to 47.5% (approx) of the current value.

2. There is a 75.7% chance that this residential real estate sub-market will fall below its current value within the next 5 years.

3. There is a 24.3% chance that this residential real estate sub-market will not fall below it's current value within the next 5 years

In determining the present invention, the Applicant's research indicates that based on historical data, residential property sub markets specified in terms of geographic location (zip / postcode), type (house / non house) and price (subdivisions /categories) have:

- Substantially different risks of negative equity,
- Substantially different financial performance characteristics,
- Different trend growth rates and,
- Different probabilities of market value rise or fall.

Because the present invention is forward looking i.e., looking at what might happen at any time in the next 5 years, and expressed in terms of probabilities, the results can be used to help any business involved in residential finance to:

- Identify and measure detailed subdivisions of risk
- Manage and mitigate that risk,
- Set explicit risk policies and strategies,
- Direct business to where the greatest risk adjusted rates of return can be gained,
- Provide for capital adequacy on a more accurate basis,
- Provide for VAR (Value at Risk) input,
- Move away from intuitive or semi empirical measures of risk.

Equally, the present invention may be applicable to many other financial instruments (property, shares, etc ...) against which a financial facility such as a loan might be granted and which instrument fluctuates/changes in value or market price. Most commonly, this would be property, but the principles could be applied generally. The type of investment against which the loan is granted would need to be able to be grouped into sufficiently homogenous subsets for analysis to be meaningful. For example, loans secured against business operations would need to be assessed against the on-going value of a business. Analysis of loans secured against a share portfolio of, for example, the All Ordinaries, may also be contemplated in accordance with the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

A preferred embodiment of the present invention, which relates to residential real estate, will now be described. It is to be borne in mind that the present invention also has similar application to many other financial instruments or properties:

1. DATA :

An embodiment of the present invention, directed at residential real estate uses residential real estate historical sales data that is sourced from either the Valuers General office's or from private data resellers. In the USA, data is more freely available than in Australia and thus it should be easier to obtain the necessary data.

In the first instance, historical sales data from as many years as possible is required. 10 years would probably be a minimum. In Victoria, we are using 16 years of data.

Because the data is from different sources, it contains a variety of fields, formats, and is of varying quality. The data needs to be standardised in its format, fields, and the like before they can be agglomerated into one data file. The required data fields are price, date of transaction, property type (house or flat/unit) and postcode. Data for land sales are not analysed.

In Victoria, there are 1.6 million sales recorded between 1985 and 2001. In all, the model would use about 6 million records of base data and each record would have 4 fields.

The database associated with the present invention would be updated periodically and probabilities re-calculated. Each year, another 500,000 records

could be added. If updated on a quarterly basis, 125,000 records would be added.

Historical output from the present model would also be collected so that, in future, the dynamics of the RRE markets could be displayed and analysed.

2. DATA CLEANING AND CHECKING:

The data would be cleaned and checked using a purpose built, rules based algorithm. We wish to identify and remove mathematically intractable, inconsistent, illogical and substandard observations, outliers, incomplete sets etc. A preferred set of rules may reflect that the data is reviewed to ensure that it consists of values that could represent a single house or flat at a given point in time, and that it may provide a reasonable basis for analysis.

2A. Initially the data is reviewed to ensure that the number of sales per annum provided for a dwelling type and suburb is greater than 20. The basis for this is that the property prices are divided into deciles. With less than 20 observations, the value of a decile can be too heavily influenced by a single data point/sale. In our research, this test omitted the most data in comparison to the other criterion below. Out of 58,180 observations, 329 were omitted, as there was too few observations to maintain statistical accuracy or relevancy.

"Points" may be just sales data values, by year, by Flat/House, and / or by suburb. They may be the individual data records.

2B. The values must be between the set ranges. For our purposes we have set the low log price to 9 ($8,103) and the high to 17 ($24,154,953)

In the same data set as in 1., 100 prices were deemed to be too small, and 62 too large.

2C. The price must be within a ratio of ± 2 from the nearest price. Note that the logged prices are estimated to 1 decimal place. The above criterion means that the value can be no more than 7 log-points from the last observation.

For example, the last logged price observed for Boronia houses was 13.4. The next observation is 14.3. There are (14.3-13.4)/0.1 = 9 logged price points between the two observations. This equates to a ratio of 2.46 which is outside the range. The price difference in dollar terms is $963,343.

2D. There must be at least 3 contiguous points when the data are grouped in bands of 0.1 by log-price. This ensures that the points are not too scattered.

Data is tested for sufficient residual numbers to determine if calculations will be statistically significant or the whole set should be identified and removed. It has been determined that if the data is too sparse, we cannot offer a service in respect of that section of the market based on that sample having sufficient statistical accuracy.

3. DATA SPLITTING:

Data are split into their respective sub-markets. A residential real estate property sub-market is a transaction:

- in a given postcode
- either a house or a unit/flat and
- within a yearly dynamic price quantile, (at this stage a decile) described by the total range of a given years sales data. This process involves sorting the data in ascending order, and then counting, for example, one-tenth of the sorted data to determine or get the first decile point. A useful and advantageous approach at present is to take the mid-point to represent the value for the range. For example, the value of the first 20th-quantile is taken to represent the value for the first decile.

When this process is complete, there are mathematically tractable data sets for some 150,000 property sub-markets across Australia. The historical performance characteristics of these property markets are now capable of being analysed, described statistically and boundary conditions set for the future based on their historical performance.

Values are obtained at the mid-points of the deciles, and these are taken as being proxies for the whole decile, and ratio values are obtained across years to get year-on-year rates of change in value of that decile. The "boundary condition parameters" are the mean, standard deviation and serial correlation values derived for such a data set, comprising the yields obtained for one decile in one house/flat set for one suburb.

This database will be unique in Australia and could form the basis of other useful work.

4. RATE OF CHANGE:

Decile mid points are calculated for each year for each sub-market and rates of change between each year's midpoints are calculated and stored. For

each sub-market we now have one datum point per year – 15 rates of change for 16 years. The rates of change are converted to the "force of interest" equivalents, by taking the natural logarithm of the 1 + the rate of change expressed as a decimal.

For example, a rate of change of 10% is expressed as ln(1.1) = 0.09531.

These data point series form the basis of subsequent calculations : mean, standard deviation, and serial correlation values.

5. DESCRIPTIVE CALCULATIONS:

The 150,000 RRE sub-markets with 15 data points each have mean, standard deviation and serial correlations with 1, 2 and 3 year lags calculated.

6. CALCULATION OF BOUNDARY CONDITIONS AND PROBABILITIES:

We are using a 5 parameter algorithm at this stage, but in the future, and depending upon data available, more or fewer parameters may be used. The key outputs are expressed as : if a loan is granted at x% of valuation, what is the likelihood that the price will fall below the loan amount over the next 5 years. Alternatively, if the lender wants there to be only a 5% chance that there will be negative equity over the next 5 years, how much should be lent as a % of sale price.

For example, with one set of parameters, if the lender is prepared to accept a 20% chance of negative equity at any time in the first 5 years, 80.6% of valuation could be lent. For a more conservative 5% chance, only 68.1% would be made available to the purchaser.

The process proceeds by assuming no capital repayments in the first 5 years, and using the Normal distribution assumption in conjunction with the parameter values calculated to derive the probabilities.

The outputs from this multi parameter algorithm are stored in a database with pre-defined fields.

The following description outlines one process of determining Loan to Value Ratios (LVR), in accordance with the present invention, by assessment of the likelihood of property values falling to any given / predetermined level. Obviously, other formulae or techniques could be used. Pairs of { } indicate the start and end of a given sub-process.

Determine or get the relevant yields from year to year, for a given sub-market criteria, such as, for each suburb, for houses/flats separately, and for each decile

$$r_{t,i} = \left[\frac{P_{(t+1),i}}{P_{t,i}} - 1\right] \times 100$$

where $r_{t,i}$ is Yield in year t and the ith quantile;
$P_{t,i}$ is the Consideration in year t and the ith quantile.

and calculate mean, delta, by

$$\delta_i = \frac{1}{n}\sum_{t=1}^{n} \ln\left(1 + r_{t,i}/100\right)$$

where $r_{t,i}$ is Yield in year t and the ith quantile;
n is the number of years with 'calculated' yields;
Mean: Sum of all values divided by the number of observations

Determine or get the relevant standard deviation and serial correlation parameter;

Standard deviation: $$s = \sqrt{\frac{1}{n}\sum_{j=1}^{n}\left(x_{i,j} - \delta_i\right)^2}$$

where s is the standard deviation of delta;
n is the number of years with 'calculated' yields'
$x_{j,i}$ is the natural log of 1 plus the yield in year j and the ith quantile

Serial correlation parameters:
these were approximated using a similar formula to below

$$r_k = \frac{\frac{1}{n}\sum_{i=k+1}^{n}(x_i - \bar{x})(x_{i-k} - \bar{x})}{\frac{1}{n}\sum_{i=k+1}^{n}(x_i - \bar{x})^2} \quad k = 0,1,2 \ldots timelag$$

Construct the Cholesky matrix C, such that C'.C produces the matrix formed by s'.R.s where

s is the column matrix of standard deviations, and R is the square matrix of serial correlations. For example, for serial correlations ρ_0 , ρ_1 and ρ_2 construct as

$$R = \begin{matrix} 1 & \rho_0 & \rho_1 & \rho_2 \\ \rho_0 & 1 & \rho_0 & \rho_1 \\ \rho_1 & \rho_0 & 1 & \rho_0 \\ \rho_2 & \rho_1 & \rho_0 & 1 \end{matrix}$$

For a large number of simulations (e.g. 10000) {

Set an arbitrary initial property value

Construct column matrix X of the most recent yields in reverse order. For example, if the most recent log yields are y_1, y_2, y_3, construct as y_3, y_2, y_1,0

For each of five years {

Solve for z such that $z=C^{-1}(X-\mu)$ where μ is a column matrix of the mean returns.

Derive z4 as a Normal(0,1) variate.

(We do this using the Box-Muller formulae, but any method would suffice)

Calculate simulated returns as μ + C*z

Retain the z values for all but the most recent year, and re-position the remainder so that they relate to one year earlier;

From the current year yield returned, calculate the revised estimate of a property value as last value times Exp(Current Year's return value).

}

Take the lowest value of the property over the five year period

Divide the lowest value by the original property price at time 0 to obtain a price ratio

The % chance that a residential real estate sub-market will fall below its current value within the next 5 years is estimated accordingly.

}

7. DATABASE:

Database Front End:

At this stage, the output data stored in the database can be interrogated, picked, re-arranged and re-expressed in a number of ways to answer many different types of questions.

An example given previously was:

Example 1 - Ballarat decile 1 (lowest 10%) houses:

A. To be 95% confident of no negative equity in this RRE sub-market, lend up to 89% (approx) of the current value.

B. There is a 23.3% chance that this RRE sub-market will fall below its current value within the next 5 years.

C. There is a 76.7% chance that this RRE sub-market will not fall below it's current value within the next 5 years.

Example 2 - Toorak decile 1 (lowest 10%) houses:

A. To be 95% confident of no negative equity in this RRE sub-market, lend up to 47.5% (approx) of the current value.

B. There is a 75.7% chance that this RRE sub-market will fall below its current value within the next 5 years.

C. There is a 24.3% chance that this RRE sub-market will not fall below it's current value within the next 5 years.

Problems & Solutions:

The following is a summary of the current problems or limitations that various business types within the financial sector experience and how the present invention(LR) helps to solve these problems.

Current Problems: **Banking:**	**Invention (LR) Solutions:**
The current 80% LVR method of risk assessment is discrete and non-continuous. Currently, from the banks point of view, a security is either risky or not risky.	LR may identify and measure security risk at whatever LVR is proposed. LR allows the lender to measure the quantum of security risk for any combination of LVR in any RRE market.
"Safe" lending opportunities at LVR's greater than 80% are not identified. Bank misses business opportunity and forces mortgage insurance onto customer unnecessarily.	LR may identify these opportunities.

"Risky" lending commitments are made at LVR's less than 80% and are not recognised. Bank has no mortgage insurance and is carrying extra risk on its books.	LR may identify these potential commitments.
Lending policy and exclusions made on the basis of intuitive feel and semi-empirical studies.	LR allows RRE risk identification process empirical and objective. LR is a mathematically "continuous" measure of RRE risk over a very large number of RRE sub-markets. LR is also a dynamic measure of RRE risk and may be updated monthly, quarterly etc.
Lending exclusions are made on the basis of broad rules / policies eg: no lending at greater than 20km from the CBD, no provincial lending, no apartments or expensive houses.	LR may dynamically calculate the risk for up to 20 property sub-markets in any postcode where data exists. Risks vary even in the one suburb and simple blanket exclusions or inclusions are an unsophisticated way of setting lending policy. LR allows lending policy to be set on the basis of an explicit level of risk that can be set by policy.
Bank interest rates are not priced on the basis of real risk to the lender.	LR, by allowing lenders to measure the risk of negative equity, will allow interest rates to be priced on a risk adjusted basis.
Lending rates set at one level are a form of cross subsidisation when risk is considered.	Banks are striving to eliminate cross subsidies between products. LR will allow them to move closer to removing interest rate cross subsidies and to price loan products closer to their true cost.
RRE is considered to be non-risky	Whilst the bulk of RRE may fall into this category, the ability to be able to identify the edges or tails of the risk distribution is very important and useful. LR allows banks to do this.
Default rates in RRE in Australia are low.	Default rates are inversely proportional to economic and real estate levels. For example, Australian RRE levels are, as of April 2002, high and default rates low. Default rates will and can change by up to 300%. Default rates are preceded by distress and much bank effort and expense. LR may identify those loans where negative equity is a high probability and where potentially extra effort and administration costs may be incurred.

Default rates in RRE in the USA are high.	The borrower is not personally liable for housing loans in the USA, unlike Australia. Borrowers are more likely to throw their keys on the desk and walk away. The identification and measurement of the probability of negative equity has greater potential to help lenders in the USA through interest rate pricing and selective business.
No empirical measure of risk exists for the overall market.	LR may allow calculation of the systematic level of risk in the market. As market risk increases or decreases, banks can adjust their lending policy to become more or less risk averse.
Banks have said that they want to improve the way they assess risk for their loan portfolios.	LR may be further developed / modified to calculate loan portfolio risk. Greater stratification of risk (identifying more types of risk levels) means that banks have greater ability to manage and control that risk.
Securitisation offerings are generally assembled into packages or tranches of similar types of loans that should have similar risks. Sorting criteria may be LVR, location, age, credit risk.	LR allows for a more precise assemblage of similar risk securities. Banks can move a step closer to bundling and selling different risk grades into capital markets. This will allow banks to develop sub-prime lending markets with different interest rates.
With Basel 2 accord, capital adequacy requirements for loans can be determined by approved in house risk management systems. Where less risk can be demonstrated, capital adequacy requirements for housing loans can be reduced below 0.5.	LR may form an important part of Basel 2 in house risk management system. By moving away from LVR and measuring probabilities of negative equity or capital loss, a more sophisticated risk process is possible.

Similar industry relevant issues are applicable to mortgage insurance, securatisation and ratings processes.

As the present invention may be embodied in several forms without departing from the spirit of the essential characteristics of the invention, it should be understood that the above described embodiments are not to limit the present invention unless otherwise specified, but rather should be construed broadly within the spirit and scope of the invention as defined in the appended claims. Various modifications and equivalent arrangements are intended to be included within the spirit and scope of the invention and appended claims.

CLAIMS:

1. A method of determining the risk of capital value of a financial instrument falling below a pre-determined ratio of the financial instrument's property value at sale, the method including:

a) obtaining data related to the value of the property,

b) determining which of the data fit within predetermined guidelines, and retaining that data,

c) grouping the retained data, in accordance with sub-market criteria,

d) determining a mid-point value of each of the grouped data, together with corresponding mean, standard deviation and serial correlation values, and

e) determining, relative to the mid-point, mean, standard deviation and serial correlation values, the likelihood the property value will fall below the predetermined ratio.

2. A method as claimed in claim 1, wherein the data obtained related to property value is over a period of at least 10 years.

3. A method as claimed in claim 1 or 2, wherein the guidelines include at least one of:

i) reviewing that a property type of each financial instrument has at least 20 points,

ii) setting a market price for each property within a range,

iii) a market price being within a ratio of 2 from the nearest price, and

iv) having 3 contiguous points in a scale of 0.1 in logged prices.

4. A method as claimed in any one of claims 1 to 3, wherein the sub-market criteria includes post-code, type of property, yearly dynamic price quantile.

5. A method as claimed in any one of claims 1 to 4, wherein at least one of steps b) to e) of claim 1, are carried out in accordance with a predetermined instruction set operating on a processor device.

6. A method of assessing whether a property value is likely to fall to a predetermined value, the method including:

determine the relevant yields from year to year, for a given sub-market criteria, according to a formula

$$\boxed{r_{t,i} = \left[\frac{P_{(t+1),i}}{P_{t,i}} - 1\right] \times 100}$$

where $r_{t,i}$ is Yield in year t and the ith quantile;

$P_{t,i}$ is the Consideration in year t and the ith quantile;

and calculate a mean, delta, by

$$\boxed{\delta_i = \frac{1}{n}\sum_{t=1}^{n} \ln\left(1 + {r_{t,i}}/{100}\right)}$$

where $r_{t,i}$ is Yield in year t and the ith quantile;

n is the number of years with 'calculated' yields;

Mean is sum of all values divided by the number of observations;

determine the relevant standard deviation and serial correlation parameters, according to a formula

standard deviation: $\boxed{s = \sqrt{\frac{1}{n}\sum_{j=1}^{n}\left(x_{i,j} - \delta_i\right)^2}}$

where s is the standard deviation of delta

n is the number of years with 'calculated' yields

$x_{j,i}$ is the natural log of 1 plus the yield in year j and the ith quantile

serial correlation parameters approximated using a formula:

$$\boxed{r_k = \frac{\frac{1}{n}\sum_{i=k+1}^{n}(x_i - \bar{x})(x_{i-k} - \bar{x})}{\frac{1}{n}\sum_{i=k+1}^{n}(x_i - \bar{x})^2} \quad k = 0,1,2 \ldots timelag}$$

construct the Cholesky matrix C, such that C'.C produces the matrix formed

by s'.R.s where

s is the column matrix of standard deviations, and R is the square

matrix of serial correlations, such that, for serial correlations ρ_0, ρ_1 and ρ_2 construct as

$$R = \begin{matrix} 1 & \rho_0 & \rho_1 & \rho_2 \\ \rho_0 & 1 & \rho_0 & \rho_1 \\ \rho_1 & \rho_0 & 1 & \rho_0 \\ \rho_2 & \rho_1 & \rho_0 & 1 \end{matrix}$$

for a large number of simulations (e.g. 10000) {

set an arbitrary initial property value;

construct column matrix X of the most recent yields in reverse order, such that, the most recent log yields, y_1, y_2, y_3, construct as y_3, y_2, y_1,0

for each of five years {

solve for z such that $z=C^{-1}(X-\mu)$ where μ is a column matrix of the mean returns;

derive z4 as a Normal(0,1) variate;

dalculate simulated returns as μ + C*z

retain the z values for all but the most recent year, and re-position the

remainder so that they relate to one year earlier;

from the current year yield returned, calculate the revised estimate of a property value as the last value multiplied by exp(current year's return value);

}

take the lowest value of the property over a predetermined period;

divide the lowest value by the original property price at a time 0 to obtain a price ratio;

determine whether the price ratio is equal to or less than the predetermined value

}.

7. A method as claimed in claim 6 wherein, the given sub-market criteria is at least one of the following:

a) suburb;

b) house or flat, and;

c) decile.

8. A method as claimed in claim 6 or 7 wherein, z4 is derived using a Box-Muller formulae.

9. A system operable to perform the method as claimed in any one of claims 1 to 5 or 6 to 8.

10. A computer program product including:

a computer usable medium having computer readable program code and computer readable system code embodied on said medium for determining the risk of capital value of a financial instrument falling below a predetermined ratio of the financial instrument's property value at sale within a data processing system, said computer program product including:

computer readable code within said computer usable medium for performing a method as claimed in any one of claims 1 to 5.

11. A computer program product including:

a computer usable medium having computer readable program code and computer readable system code embodied on said medium for assessing whether a property value is likely to fall to a predetermined value within a data processing system, said computer program product including:

computer readable code within said computer usable medium for performing a method as claimed in any one of claims 6 to 8.

12. A method of providing a financial facility for a transaction involving a financial instrument including the steps of a method as claimed in claims 1 to 5 or 6 to 8.

13. A method, system or product as herein disclosed.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00448

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: G06F 17/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPTO, DWPI (mortgage, loan, lend, ratio, LTV, LVR, real estate, property, residential, home, risk, geographic, statistical, insurance, US: 705/4, ECLA: G06F 17/60D4)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2 363 366 A1 (REAVS INFORMATION TECHNOLOGIES, CA) the whole document (in particular, page 12, line 15 – page 16, line 20	1-5, 9-10, 12-13
A	WO 02/29690 A2 (HERZFELD), 11th April 2002 the whole document	1-13
A	US 6,058,369 A (ROTHSTEIN), 2nd May 2000 the whole document	1-13

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 May 2003	30 MAY 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **J. W. THOMSON** Telephone No : (02) 6283 2214

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/0047327 A1 (COURTNEY), 29th November 2001 the whole document	1-13
A	US 2001/0029477 A1 (FREEMAN et al), 11th October 2001 the whole document	1-13
A	US 5,361,201 A (JOST et al), 1st November 1994 the whole document	1-13
A	CA 2,086,269 A1 (WILLIS), 25th June 1994 the whole document	1-13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00448

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
CA	2363366	CA	2326055	US	20020099650		
WO	0229690	US	20020103750	AU	1151802		
US	6058369	US	5636117	CA	2062368		
US	20010047327	NONE					
US	20010029477	US	6249775	WO	9903052	EP	0996911
		AU	8167598				
US	5361201	NONE					
CA	2086269	NONE					

END OF ANNEX